# Self-reducing Copper Nanocrystals - How Surface Chemistry affects Sintering

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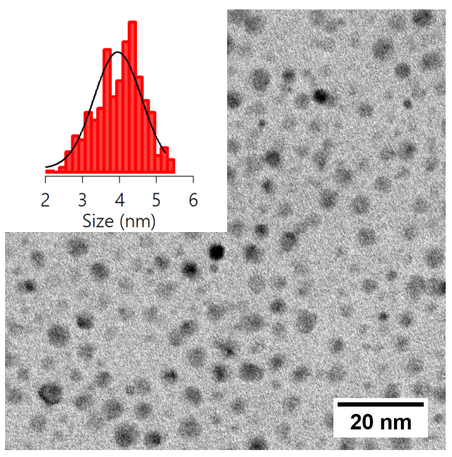
## Introduction

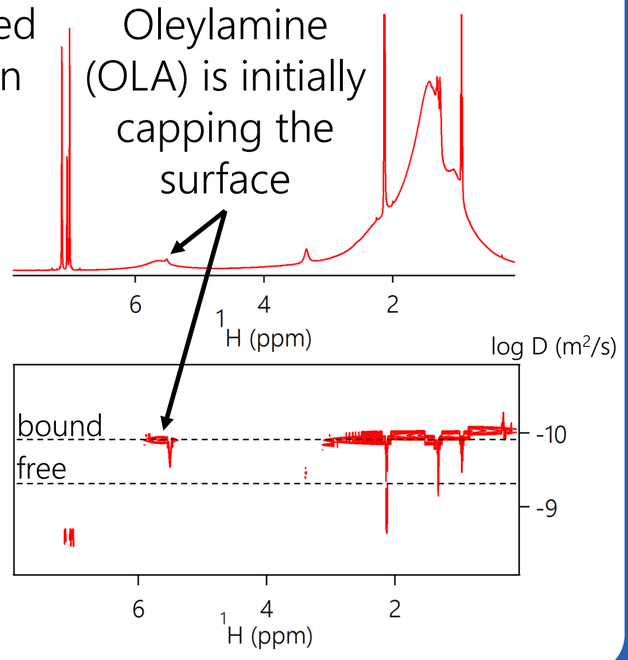
The study of Copper Nanocrystals (Cu NCs) for printed electronics is blossoming due to Cu's high conductivity and low cost. In order to develop CuNC-based inks, most of the research efforts focused on preventing the inherent oxidation of Cu. In this regard, unravelling the surface chemistry of such Cu NCs is crucial to understand the redox dynamics.

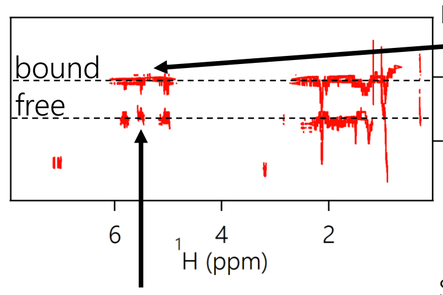
We investigated: The interaction of the ligands with CuNCs surfaces → and its effects on → The sintering and reduction of the deposited CuNCs

4 nm Cu NCs were obtained *via* thermal decomposition of $Cu(HCO_2)_2$ in OLA



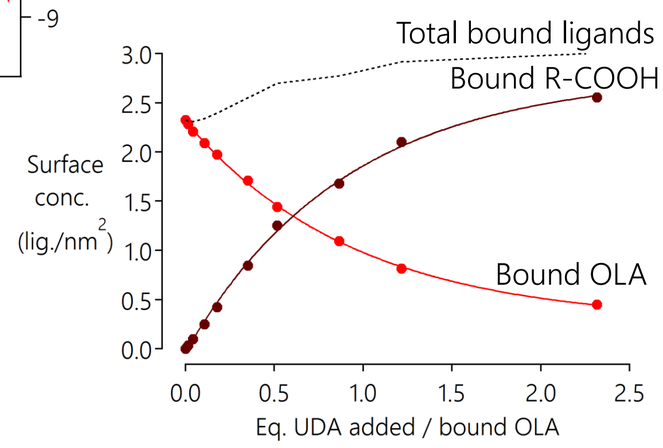

Oleylamine (OLA) is initially capping the surface




Carboxylic acids bind to the NCs

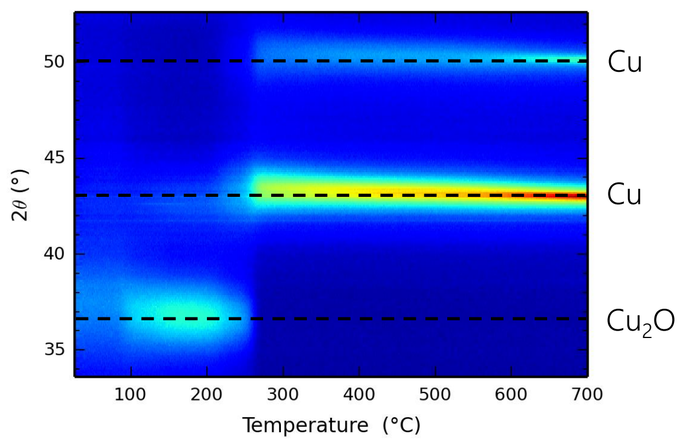
OLA is also released upon R-COOH addition




Carboxylic acids both bind and induce the release of OLA whilst increasing ligand coverage

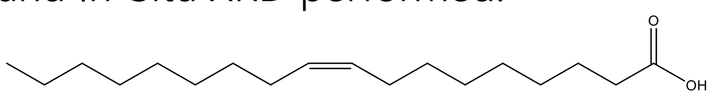
### In-situ XRD

Cu NCs oxidize upon air exposure…

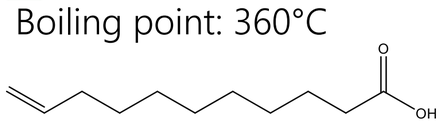



…yet they reduce when sintered in $N_2$

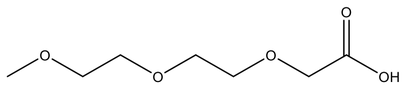
3 R-COOH ligands have been exchanged and In-Situ XRD performed:



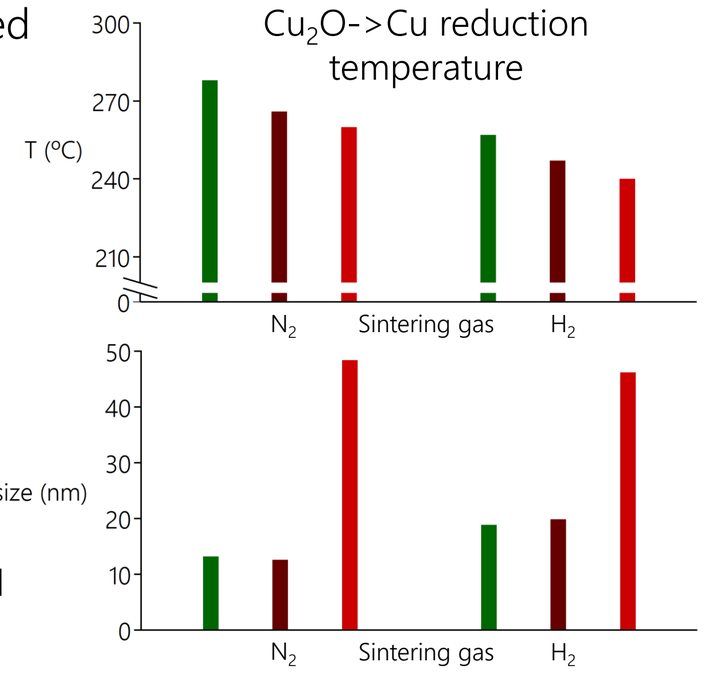
Oleic Acid
Boiling point: 360°C



Undecylenic Acid
Boiling point: 275°C



2-[2-(2-Methoxyethoxy)ethoxy]acetic acid
Boiling point: 140°C




## Conclusions

The developed Cu NCs synthesis produced an ideal material to study the interplay between its surface and the ligands.

The self-reducing behavior of such Cu NCs at relatively low temperatures deals with the issue of the inherent oxidation.

2-[2-(2-Methoxyethoxy)ethoxy]acetic acid is a promising ligand. It presents the lowest reduction temperature and the largest grain size. Moreover, the alkoxy chain makes the particles soluble in polar solvents more suitable for printing.

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